

The Limits of Natural Selection

For billions of years, populations of organisms on Earth have adapted to changing environments through natural selection. For example, a population of moths lived on a type of tree with light colored bark, and most of them had light colored wings that helped them hide on the tree bark. Over many years, pollution caused the bark of the trees to darken in color. This meant that moths in the population whose wings were darker in color had an easier time hiding, so they were able to survive longer and reproduce more. The darker color trait became adaptive. Wing color in the population shifted over time, so that more moths had darker wings.

Shifts in the distribution of traits through natural selection have often allowed populations to survive in changing environments. However, what happens when natural selection isn't enough? Sometimes the environment changes so quickly or drastically that there is not enough time for populations to adapt through natural selection. Those populations die out. When all of the populations of one species all over Earth die out, that species becomes extinct.

Some of the most famous extinct species are the dinosaurs like *T. rex* that dominated Earth millions of years ago. During the dinosaur era, Earth was a very different place, with environments, plants, and animals unlike what we see today. Dinosaurs ranged in size from larger than a school bus to as small as a chicken. They lived in varied environments and survived in many different ways, from hunting other dinosaurs to eating only plants. Then, about 65 million years ago, almost all of these dinosaur species went extinct at the same time.



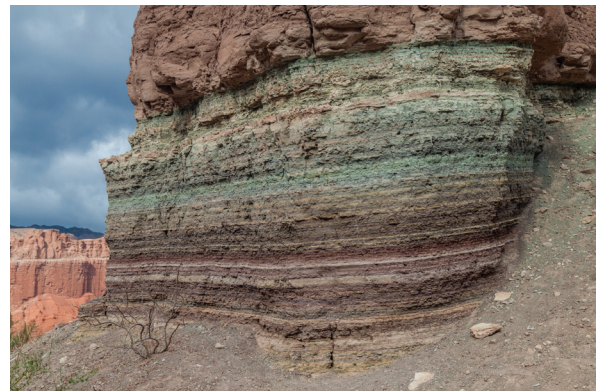
Fossils provide evidence of extinct animals such as this dinosaur.

How could such a large and diverse collection of species all go extinct at once? The answer almost certainly has to do with a drastic and relatively sudden change in Earth's climate. Around the time that the dinosaurs went extinct, a huge asteroid from space collided with Earth and massive volcanic eruptions spread lava over a large area of what is now India. Dust and ash blocked sunlight from reaching Earth's surface, making the planet cold and dark for months or possibly years. When the dust cleared, gases changed the climate again, trapping heat and making Earth hotter. These changes in climate killed organisms relatively quickly, too quickly for many populations to adapt to the new climate. In addition to the dinosaurs, the majority of other species on Earth also died out.

Does it seem surprising that a change in the environment could cause a huge number of Earth's species to go extinct? This was actually the fifth time in Earth's history that such a large number of organisms on Earth died out! Scientists call events like these mass extinctions. One way scientists know about mass extinctions is by looking at fossils in rock layers. Rock layers are a record of time, because different layers were formed in different time periods. Scientists can figure out the ages of rock layers, so they can determine when species were living based on what rock layers the fossils of a species are found in. Scientists see evidence of a mass extinction when many species of fossils are found in rock layers that formed in a certain time period, but there are no fossils of those species in the rock layers that formed in later time periods. The evidence for the mass extinction that killed the ancient dinosaurs is very clear in the rock layers. Rock layers that formed 67 million years ago contain fossils of lots of dinosaur species, but those fossils are no longer found in rock layers that formed 64 million years ago. The rock layers tell the story of a mass extinction.



Huge dinosaurs like Diplodocus roamed Earth for about 165 million years.



Scientists use fossils found in rock layers to determine when species lived on Earth and when they went extinct.

Scientists are concerned that we may be in the middle of a mass extinction right now. Over the past century, many more species have gone extinct than expected. We haven't had any huge asteroid impacts or massive volcanic eruptions lately, so if a mass extinction is indeed happening, what could the cause be? Unfortunately, the answer is that humans are changing environments too fast and too drastically for many species to adapt. Humans are clearing forests for farms and cities, catching millions of fish and other wildlife to eat, damming rivers, and adding pollution to environments. In addition, human activities such as burning fossil fuels, raising farm animals, and deforestation are causing global temperatures to increase. Although predictions about future temperatures vary, we will likely continue to experience temperature increase in the next century. Even small temperature increases can have a dramatic effect on global climate, weather patterns, and habitats. For example, raising the temperature just a couple of degrees can melt Arctic ice sheets where polar bears hunt, make it too warm for certain trees in the mountains to survive, and kill the corals that form reefs hundreds of other species depend on. When the climate changed quickly and drastically in the dinosaur era, it led to a mass extinction. Let's hope we can stop our climate from changing so much that it leads to another one! The future of Earth is in our hands.



The Tasmanian tiger is one of the many species that have gone extinct in the past century due to human activities.